

# NASA I-CNS Conference 2003

## GCNSS Demonstration Segment A Flight Demonstrations

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Contact Jodie Carvo 425.373.2783.

# Program overview

- Letter Contract signed 18 July 2002
- Formal FAA / Boeing GCNSS Kickoff Meeting conducted on 24 July
- Flight Demonstrations
  - Customer Familiarization Flight – 12 September 2002
  - Segment A Flight 1 – 22 January 2003
  - Segment A Flight 2 – 12 February 2003
- Total Program: \$46.2M
  - FAA share: \$23.2M
  - Boeing cost share: \$23.0m
- 22-month period of performance

# Systems-driven demonstration objectives

## **Segment A:**

Secure CIN Using Broadband Communications for Flight Security

- *Demonstrate feasibility of flight conformance monitoring and aircraft cabin video surveillance with on- and off-board networks*

## **Segment B:**

Global Integrated CNS Architecture Using Satellite-Based C, N, & S

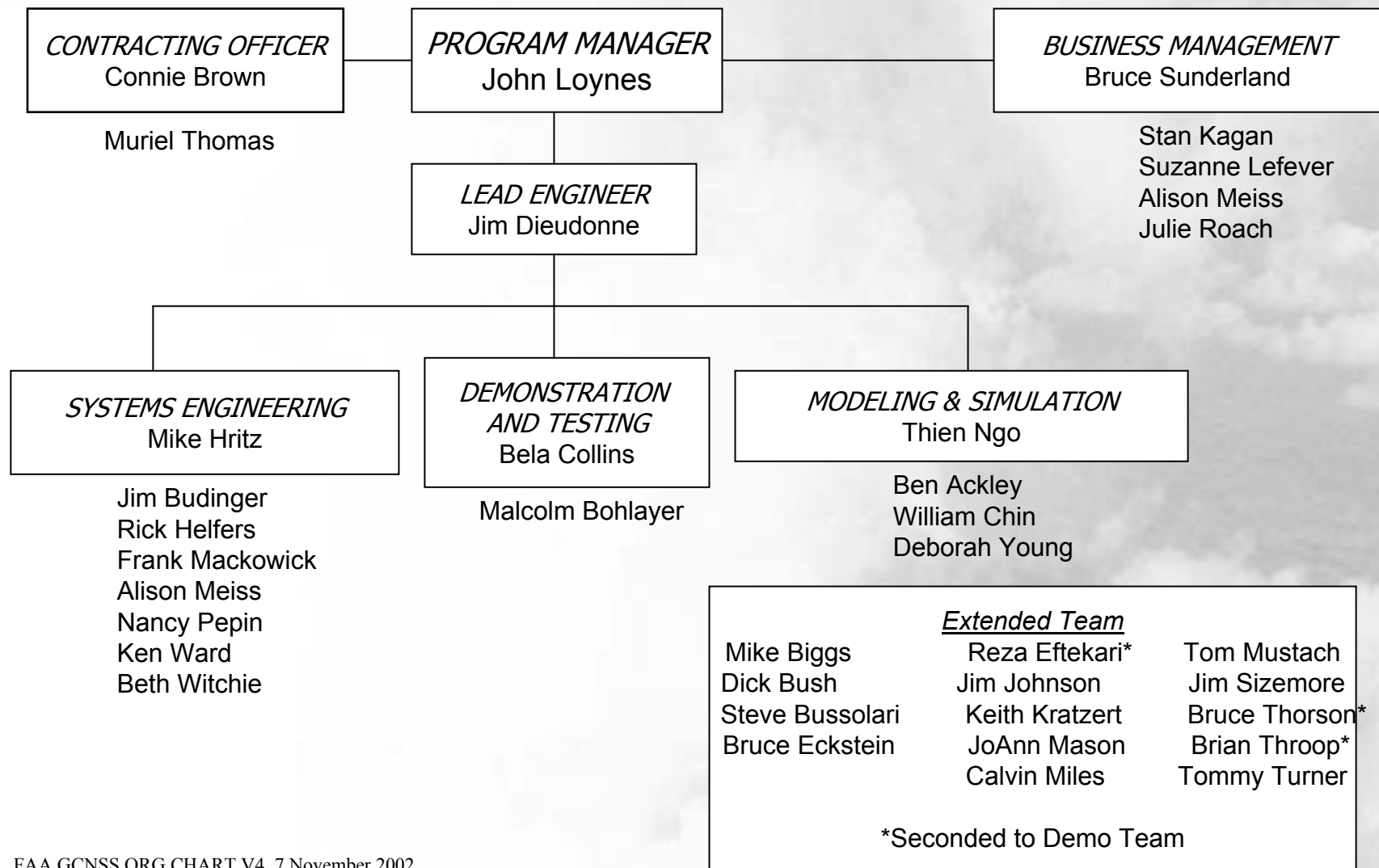
- *Demonstrate feasibility of satellite-based direct controller-pilot communications (voice and data) and ADS that would enable precision (radar-like) control in oceanic and remote domains*

## **Segment C:**

Secure, Highly Integrated CIN Using a Surveillance Data Network

- *Demonstrate feasibility of a CIN that would enable network-centric operations among ATC centers, aircraft, airline centers, etc., with surveillance published and subscribed on the network*

# FAA GCNSS organization



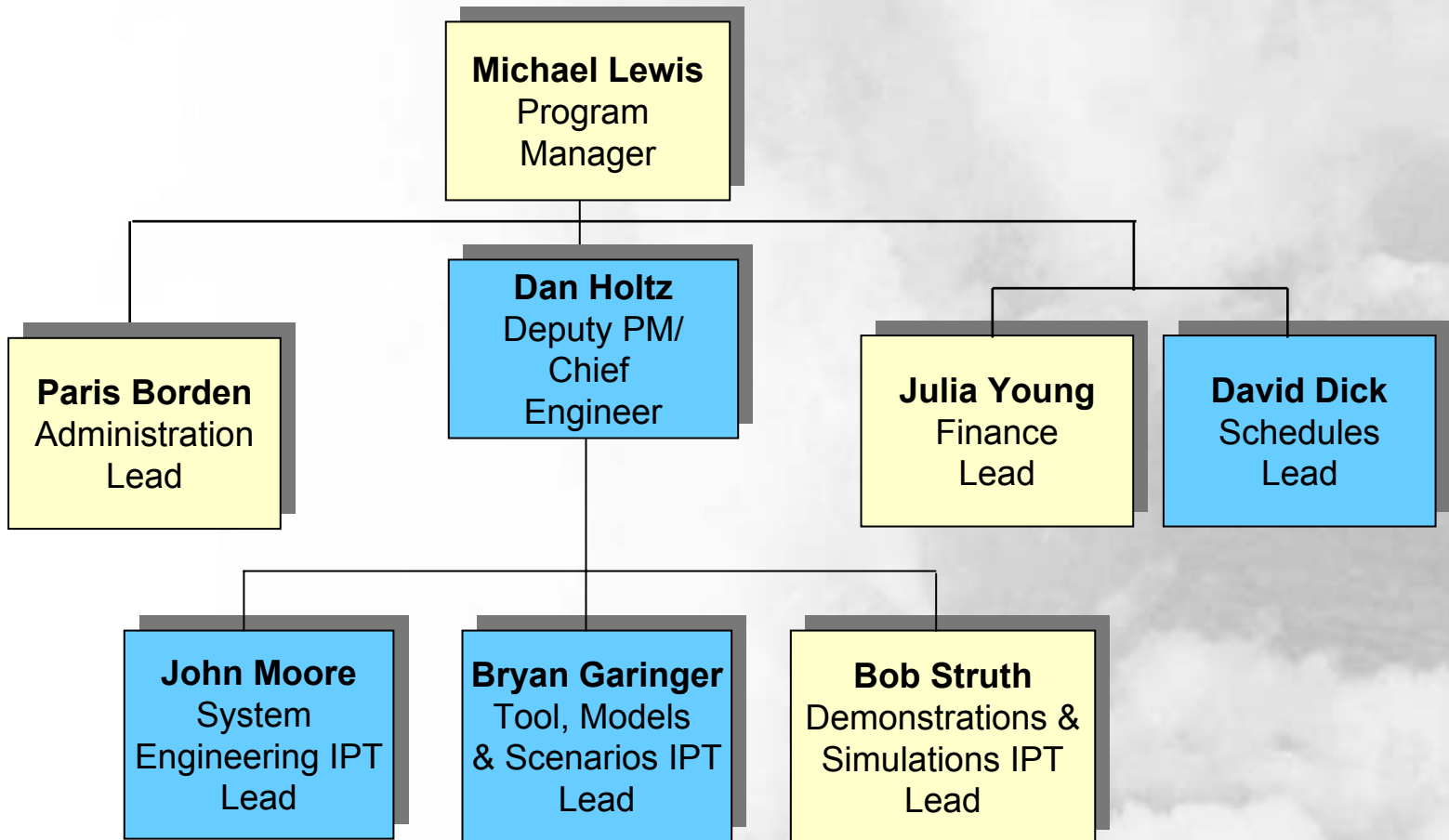
FAA GCNSS ORG CHART V4 7 November 2002



**Global CNS System Team**

# GCNSS program management

■ Factoria  
■ McLean



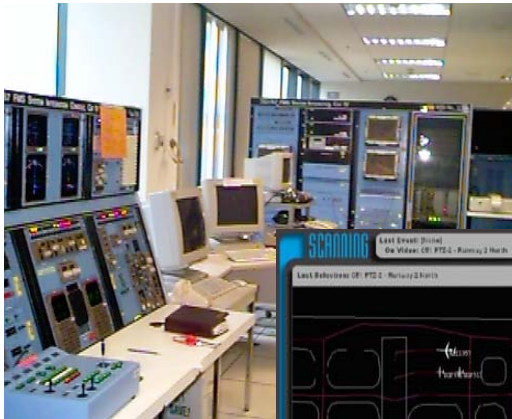
Approval: \_\_\_\_\_ Signature on File \_\_\_\_\_ Dtd 2/4/03  
Michael Lewis

# Global satellite CNS demo partners



Global CNS System Team

# Integrated three segment demonstration program (sow 3.2.2)

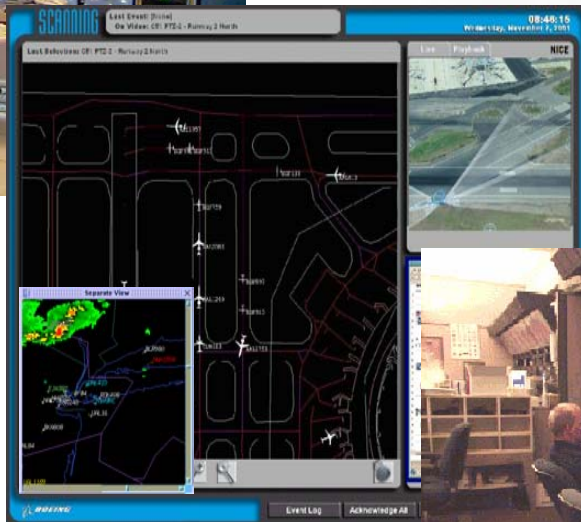


## **A: Satellite-based Navigation/Surveillance**

**Broadband Comms**  
**Trajectory Prediction**  
**Situational Awareness**

## **B: ADS-B Satellite Surveillance**

**Surveillance information**  
**integration and display (military**  
**and civilian)**  
**CIN Security & Intrusion Alert**  
**Hybrid Surveillance Architecture**  
**Oceanic – Domestic Transition**



## **C: Aircraft Ground Tracking**

**Onboard Monitoring**  
**Integrated Tools & Displays**  
**CIN Application for Command, Control,**  
**and Crisis Management**



# Demonstration Segment A Activities

6 Simulations, 7 Laboratory Demonstrations, & 10 Flight Demonstrations

## ATM/CIN

*Kauser Dar*

**SIM – 1. CIN 100 - Network Performance**

**SIM – 2. CIN 101 - Loss of Provider**

**SIM – 3. CIN 102 - Broadband Communications**

*Mark Taylor*

**LAB – 1. CIN 103 - Secure CIN Concept**

**LAB – 2. CIN 104 - Secure CIN Intrusion**

## ATM/Demos

*Ox coord*

**LAB – 4. Integrated Surveillance Concept**

**LAB – 6. Techniques/Tools/Displays for Seamless Transition**

*Mike Ryanczak*

**FLT – 6. Shared Weather Display**

*Rowin Andruscavage*

**FLT – 9. Flight Path Status to Emulated FAM Display**

## Preston– Sam Brilliant

**SIM – 6. Indications of Aircraft Flight Path Deviation**

**LAB – 5. Auto Detect and Display of Aircraft Deviation**

**LAB – 7. Auto Ground Alert for Interruption of Cooperative Surveillance**

**FLT – 7. Ground-Based Flight Deviation Alerts and Decision Aids**

**FLT – 8. Air to Ground Transmission of Aircraft Parameters for FDR/CVR/SA Display (Ground Portion)**

**FLT – 10. Link Status Monitoring and Alerts**

## CBB – Dean Miller

**LAB – 3. Broadband and Narrowband Data Transmission**

**FLT – 1. Integrated CIN and Broadband Comms Architecture**

**FLT – 2. 2-Way Sat-Based Broadband/Narrowband Comms**

**FLT – 3. Broadband/Narrowband Video Link to Ground**

**FLT – 8. Air to Ground Transmission of Aircraft Parameters for FDR/CVR/SA Display (Air Portion)**

## Autometric – Al Womble

**FLT – 5. Ground-Based Security and Surveillance Displays and Controls**

## Tools, Models, & Scenarios – Joni Robbins/Bryan Garinger

**SIM – 4. NFM-1 Operational Impacts on Domain Transition**

**SIM – 5. NFM-2 Domain Transition Communications Transfer**

## Undefined

**FLT – 4. Broadband/Narrowband Security Techniques**

### Legend

•Status only for report

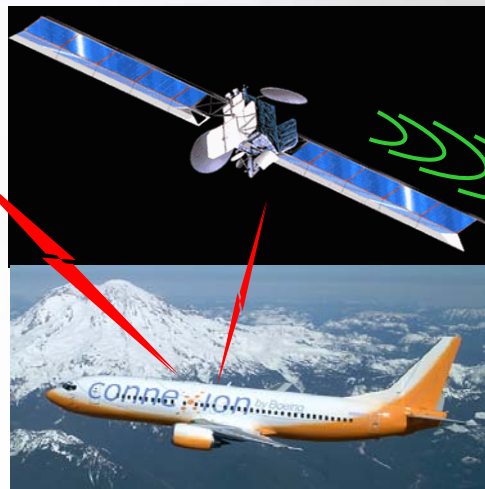
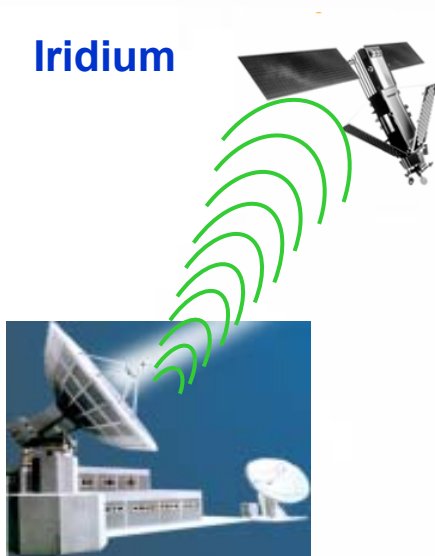
•Deleted under ECP

•Completed

•To be completed

# Segment A SATCOM links

Iridium



Ku-band  
Transmit up to 1Mbps  
Receive 5Mbps

Fiber



Connexion by Boeing<sup>SM</sup>  
Network Operations Center



- Uses Existing Satellites and Ground Networks
- Integrates Proprietary and COTS Technologies to Provide Two-Way Broadband and Narrowband Capability
- Provides Live Video, Audio, and Data to On- and Off-board Systems

## **Significant Achievement:**

***CIN-provided shared situational awareness of all demo activities***

- Connexion airplane
  - onboard wireless LAN
- Offboard WAN
  - 5 ground sites

# Example of our bandwidth capability



# Segment A flight demonstration activities

## *Integrated broadband communications network*

- Integrated communications and data network on and off aircraft

## *Two-way satellite-based communications*

- Broadband and narrowband
- Data link and point-to-point voice

## *Inflight and ground security video concepts*

- Video surveillance and recording
- Airborne and ground manipulation and storage

## *Ground-based security and surveillance displays and controls*

- Highly accurate and timely aircraft surveillance monitoring



# Segment A flight demonstration activities (cont.)

## *Shared weather information*

- Onboard display of representative radar-based convective weather
- Downlink of aircraft environment information

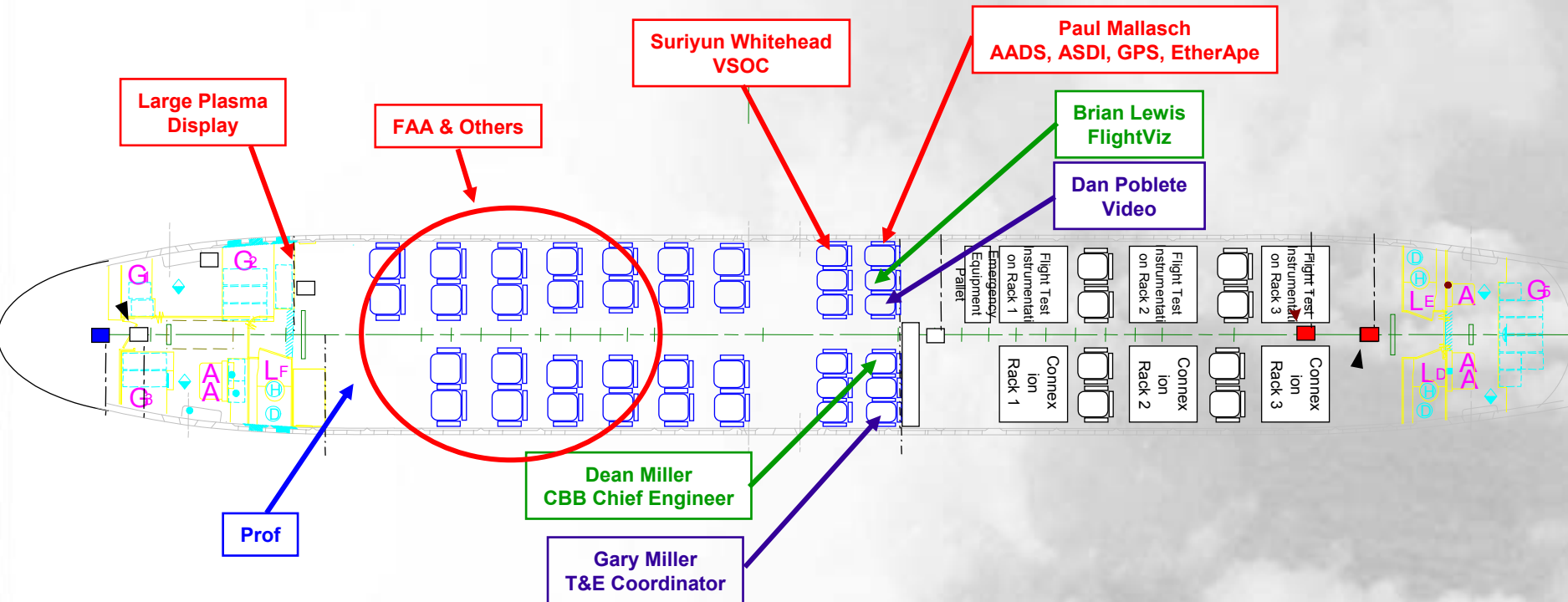
## *Aircraft deviation alerting*

- Real-time ground operator alert of flight path deviations
- Ability to provide security alert to aircraft security via onboard wireless system

## *Ground display of aircraft flight data monitoring*

- Limited display of recorded & stored aircraft flight data and security surveillance systems

# CBB #1 layout



*Shelbun Cheng roamed the cabin, assisting with PDAs and laptops  
Mark Oser sat in the back, running The Instant Messenger chat  
network and demonstrating Iridium*



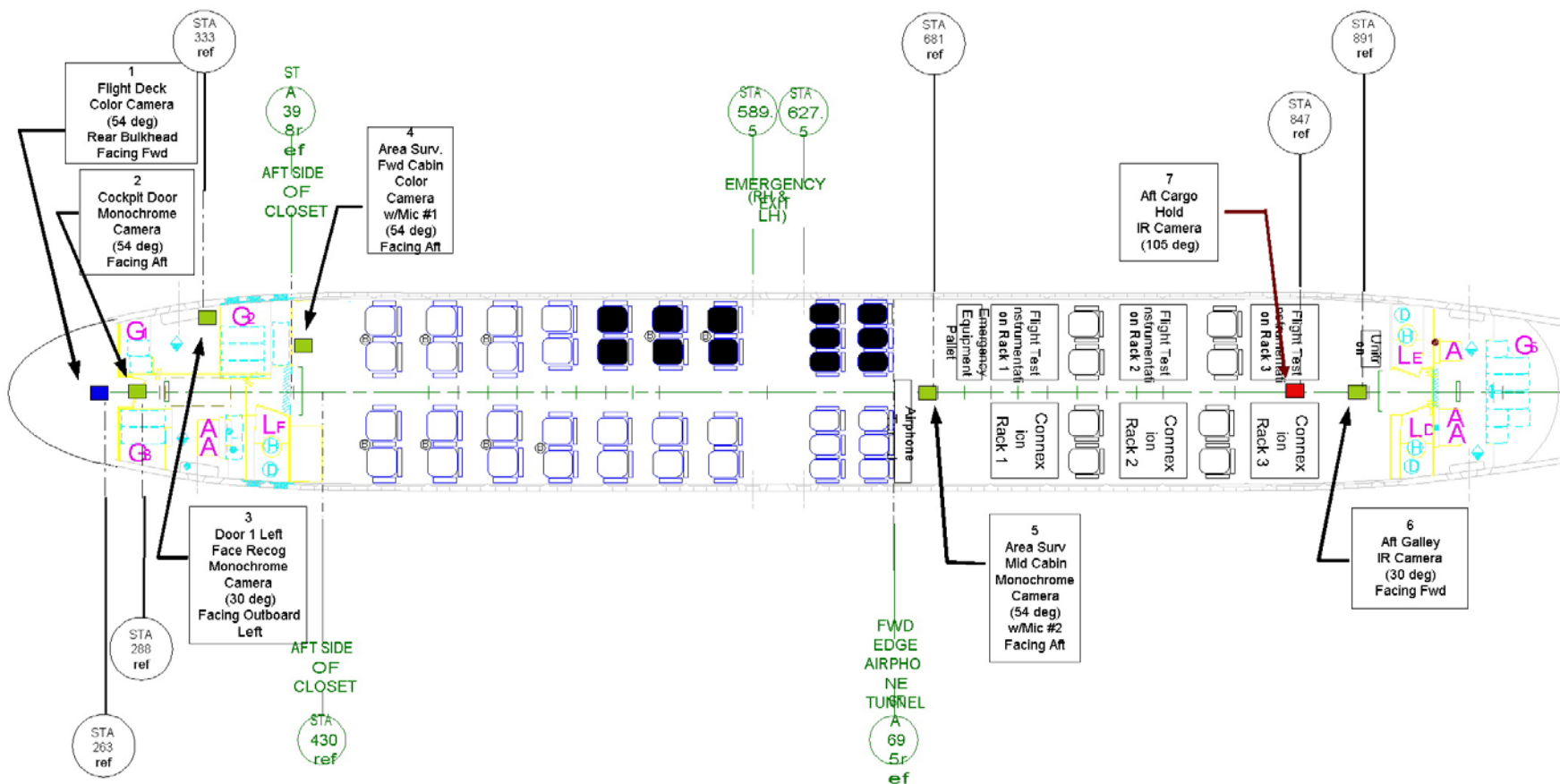
## Global CNS System Team

# Surveillance camera locations

## BLOCK 1 LOPA

### Installation Note:

All cabin camera installations will be mounted 72" or more from 0 FRP per AC 25-17A Head Strike Reqmts



Rev 8  
Dec 16, 2002

# PDA video display and control panel



- Simple intuitive controls similar to a VCR
- Fully selectable choice of single camera views – *independent and simultaneous at all CIN nodes*
  - 7 onboard cameras – B&W, color, and Infrared
    - Cabin
    - Cockpit
    - Cargo hold
- Provide access to live and recorded video feeds on PDAs and laptops

# VSOC: Alarm Mode

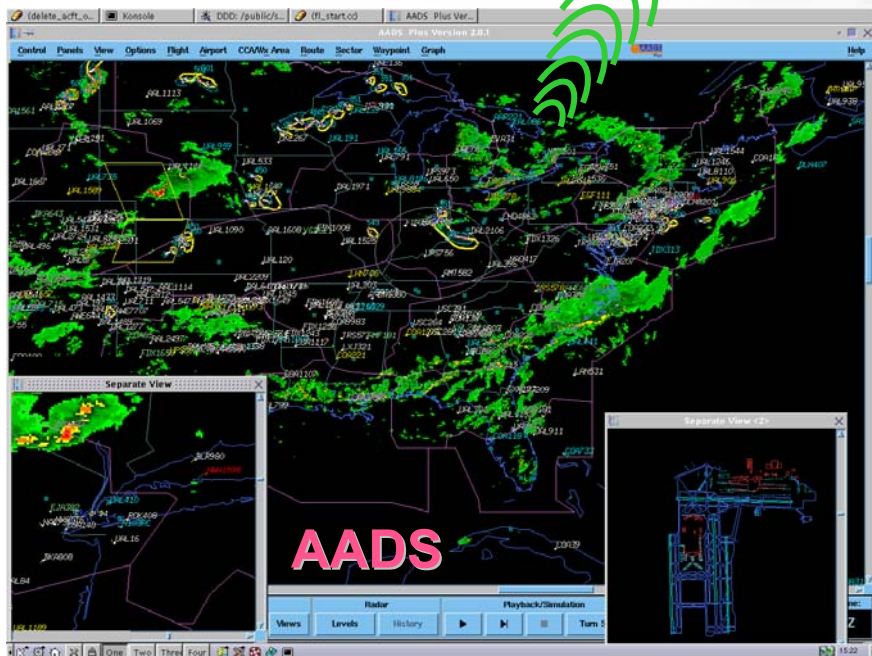


# Shared weather awareness Up and downlinked

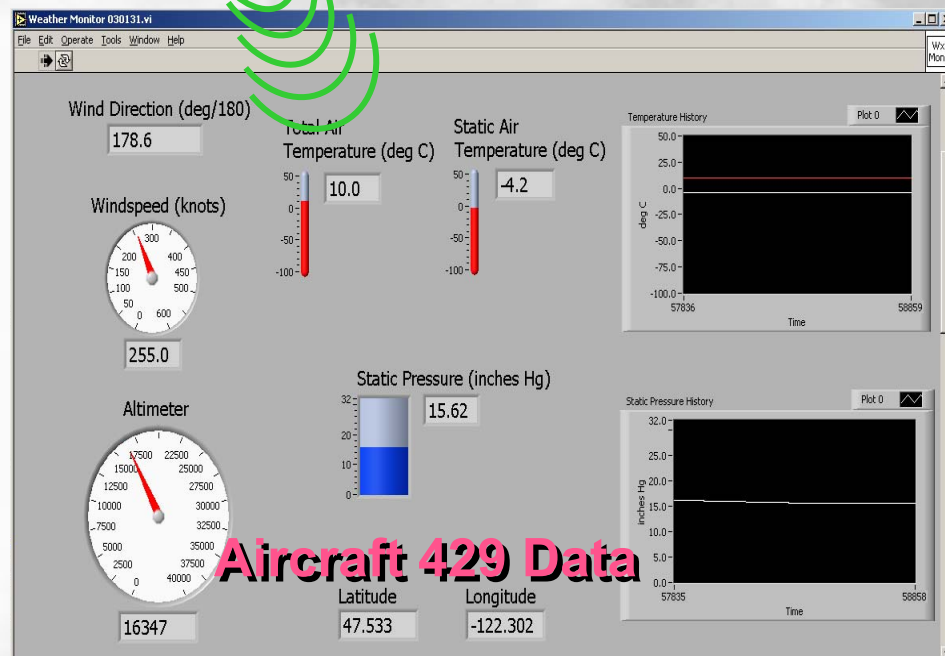
*Weather sent  
to aircraft*



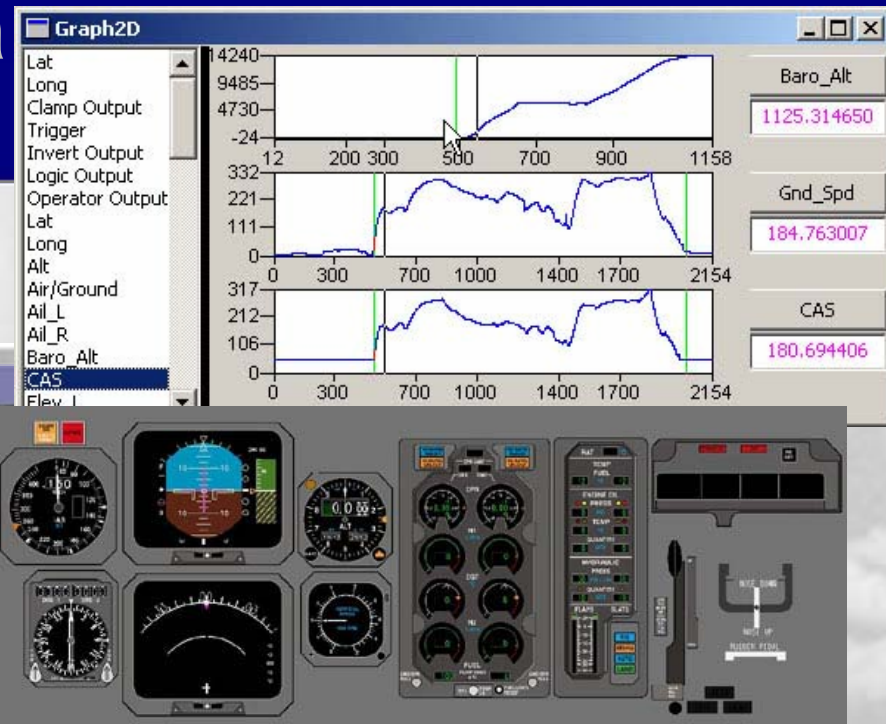
*Weather data sent  
from aircraft*



*Onboard display of representative  
radar-based convective weather*



*Downlink of aircraft environment information*



# Segment A flight statistics

Typical data transfer off the aircraft during each flight was 3 million packets worth of data (packet is up to 1.5 Kbits) with only ~500 (0.017%) “corrupted”

## Demo Flt #1

24 Gbits of video surveillance data

Amount of data captured by sniffer:

Fwd Link: 230 MB

Rtn Link: 336 MB

Peak data rates (30 second average):

Fwd Link: 318 kbps

Rtn Link: 346 kbps

## Demo Flt #2

24 Gbits of video surveillance data

Amount of data captured by sniffer: (note: sniffer filter modified to filter out intra-cabin data)

Fwd Link: 27.2 MB

Rtn Link: 42 MB

Peak data rates (30 second average):

Fwd Link: 561 kbps

Rtn Link: 419 kbps



# GCNSS Segment A flight

## Hands-on experience extras



- Onboard wireless digital voice
- Instant messaging chat room– PDA (Ku)
- Iridium phone
- Iridium instant messaging
- Iridium pager
- 2-way point-to-point voice to Boeing ATM McLean, VA
- 2-way point-to-point video to Boeing ATM McLean, VA (using Microsoft Portrait)
- e-Mail and Internet broadband connectivity
- Highlight camera IR capability
- Tungsten PDA integration

# Flight results

- All 9 flight demonstrations completed successfully (all procedures executed)
- Additional activities demonstrated
- Time at end of flight for customer walk-around observance and questions



***FAA & other customers expressed good feedback:***

- ***Questions answered***
- ***Impressive capabilities demonstrated***
- ***Wide range of activities***
- ***Excellent integration***

# Demonstration Segment A Flight 2 Video



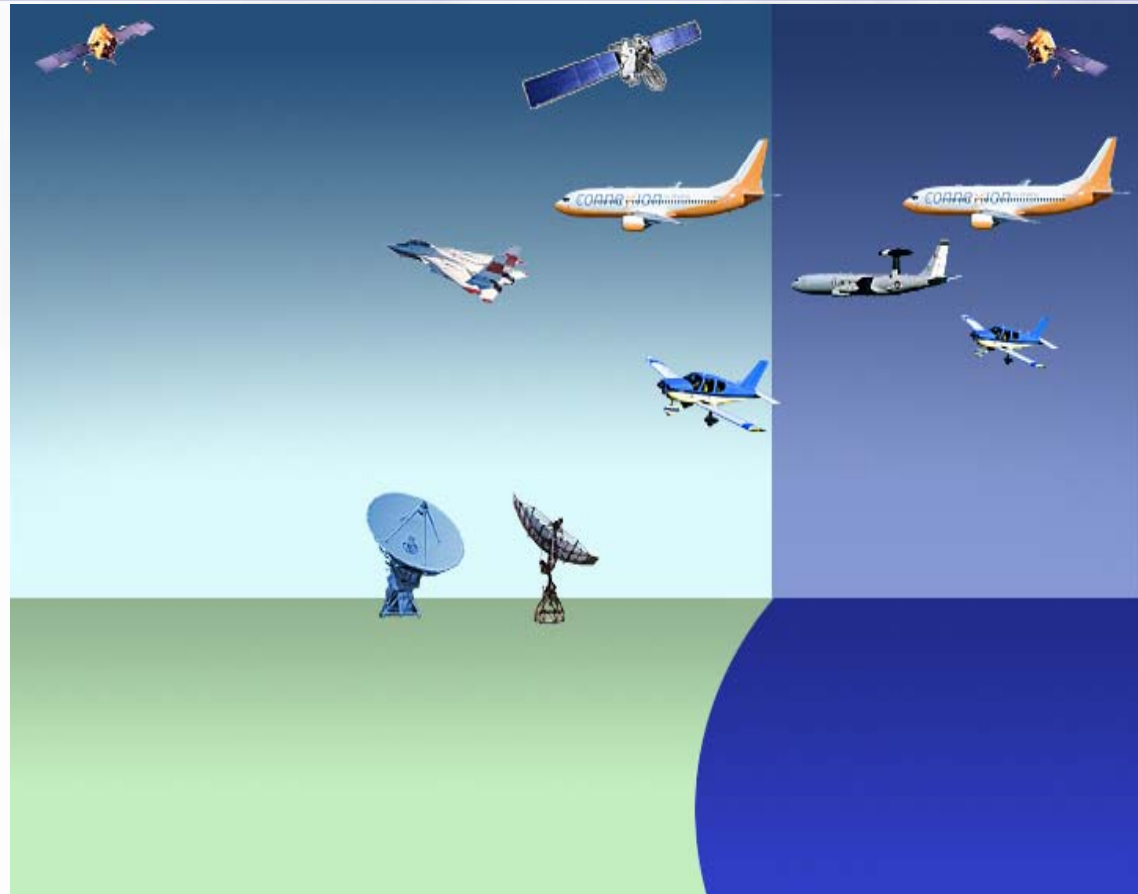
# What's next?

- Demonstration Segment A Report – June 2003
- Demonstration Segment B begins June 2003
  - Flights over Gulf of Mexico
- Segment C flight demonstration in January 2004
  - ADS-B equipped aircraft in Potomac TRACON area

# Demonstration Segment B

## ***Global Integrated CNS Architecture Using Satellite-Based CNS***

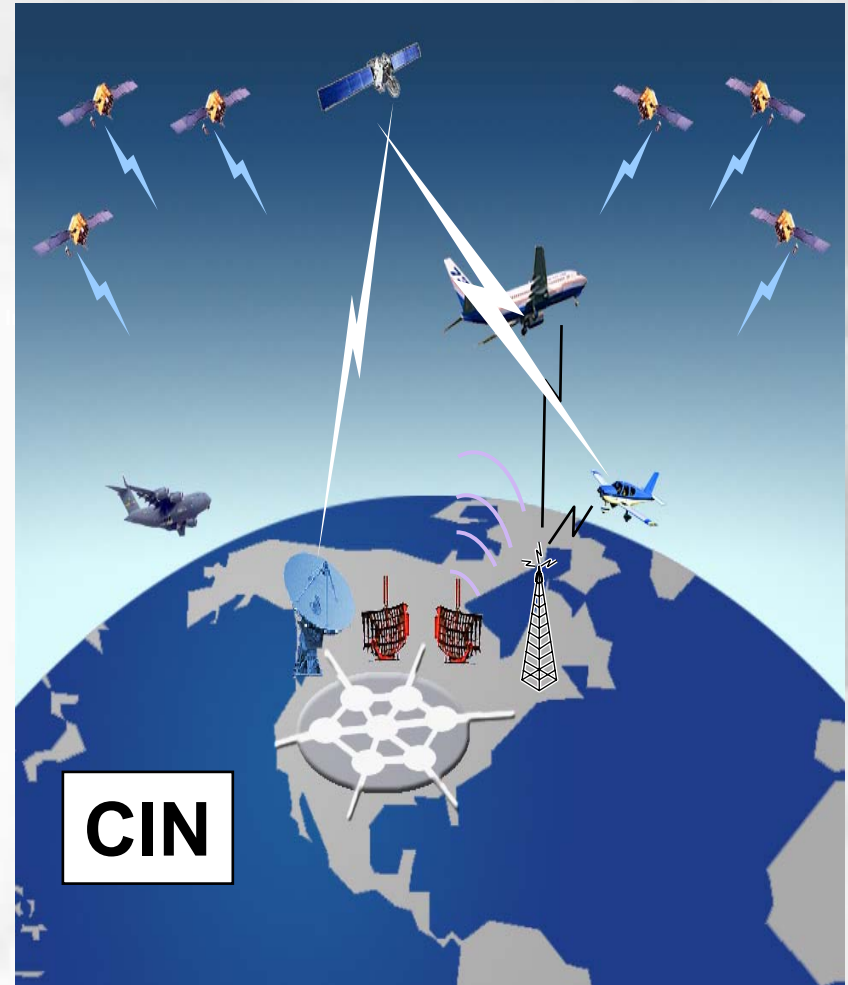
- **Three flights in Houston Airspace including Gulf of Mexico; Scheduled Dates: 11/5/03, 11/10/03 & 11/13/03**
- **Purpose: *Demonstrate feasibility of satellite-based direct controller-pilot communications (voice and data) and ADS that would enable precision (radar-like) control in oceanic and remote domains***
  - Direct controller-pilot two-way datalink
  - Direct controller-pilot two-way “party-line” voice communications (“digitized packetized voice”)
  - Radar-like surveillance using ADS via satellite
  - Seamless transition between domains (radar, ADS, & multilateration?)
  - Show flight traffic capacity increase enabled (simulation only)



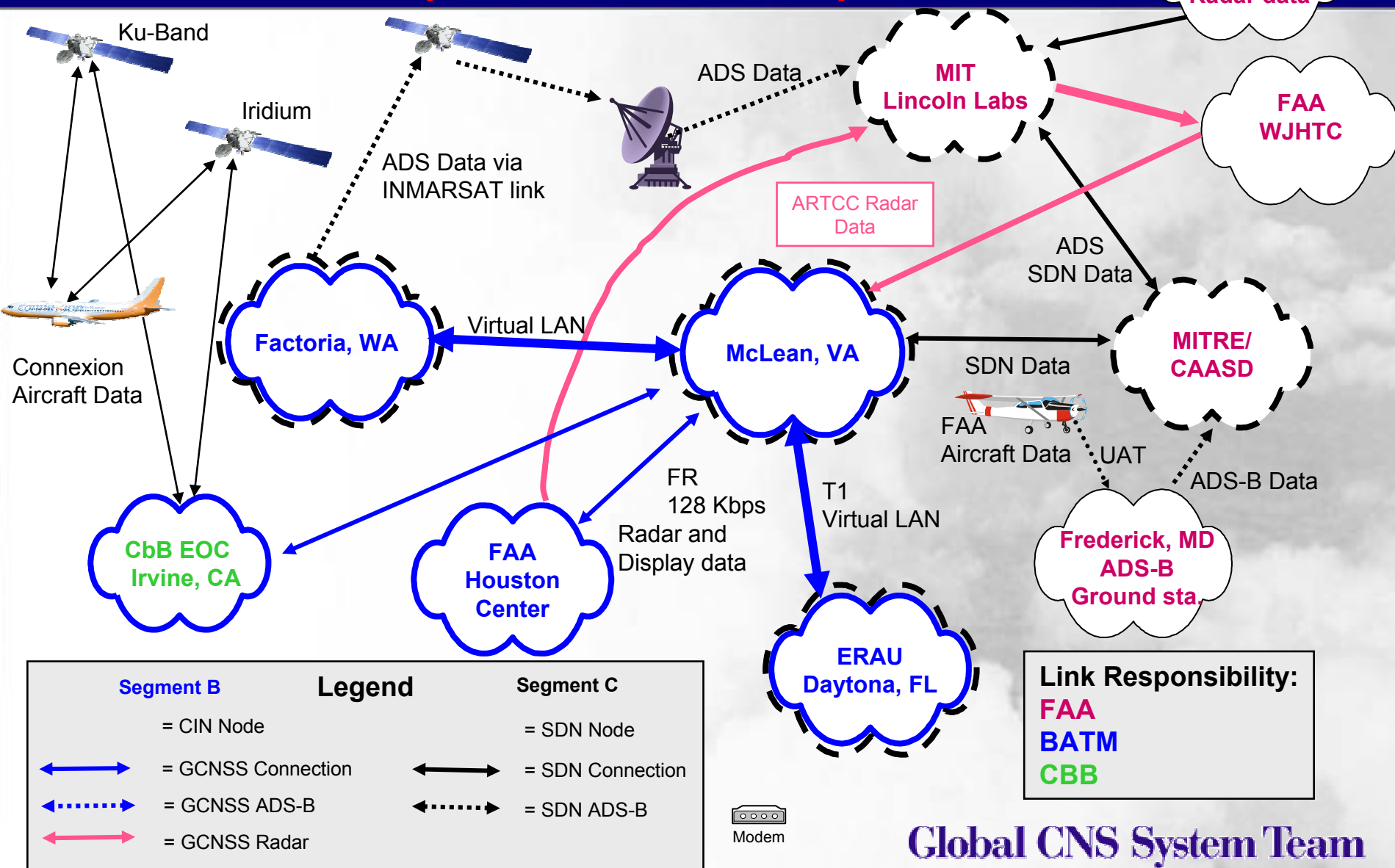
# Demonstration Segment C

## *Secure, Highly Integrated CIN Using a Surveillance Data Network*

- Two flights in Potomac TRACON in Jan '04 using FAA-provided airplane
- Purpose: *Demonstrate feasibility of a CIN that would enable network-centric operations among ATC centers, aircraft, airlines, etc., with surveillance available on the network*
  - Aircraft ADS “sensor” attached to SDN via satellite
  - Multi-sensor integration to eliminate surveillance boundaries
  - Live ADS and multiple radar sites available on SDN
  - CIN with 3-4 nodes (TRACON, enroute center, simulated aircraft, and/or airline AOC) and infosec, mobility, QoS mgt, and multicast



# Segment B and C Network Functional Architecture (Rev. 7, 050503)





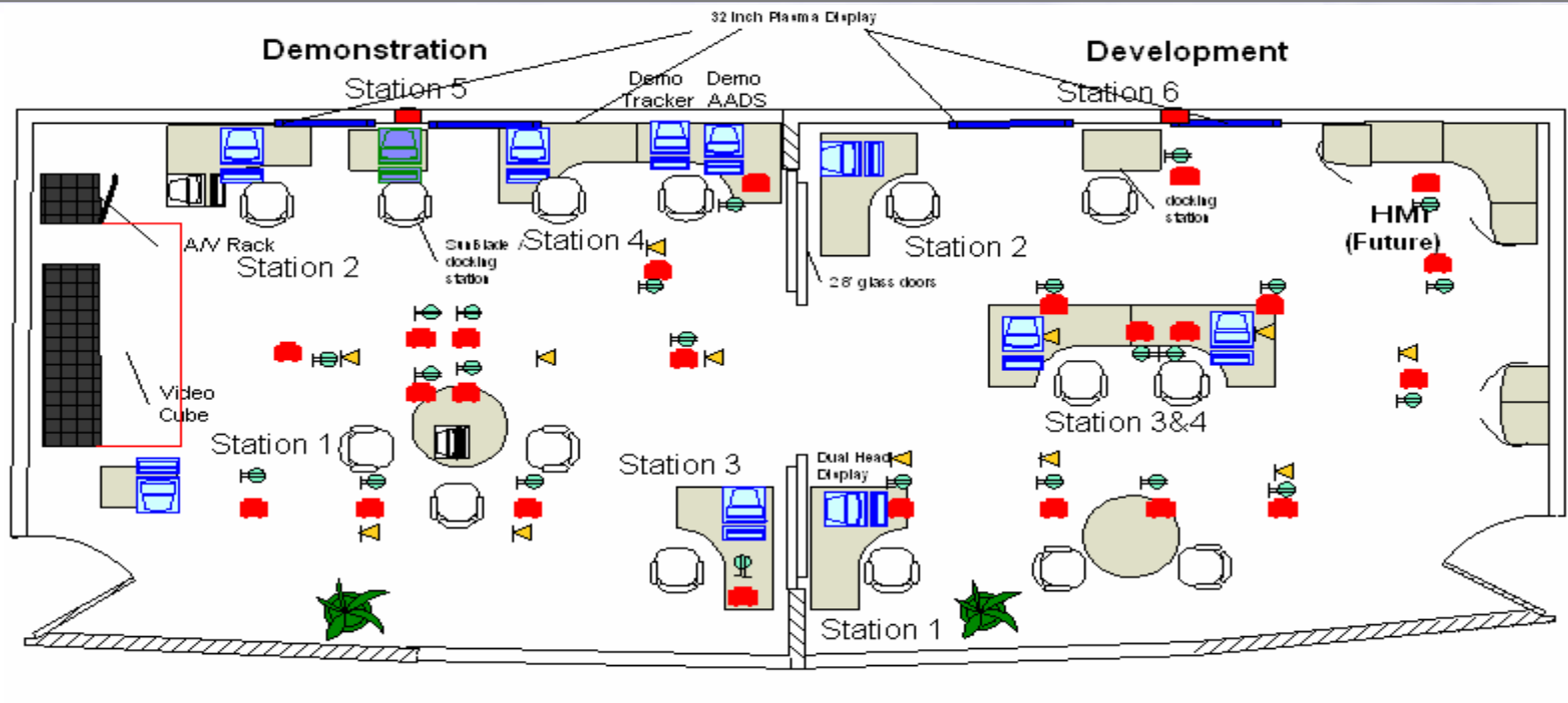
# What a Team!!!



**Global CNS System Team**

# BACKUP

# McLean lab



- AADS workstation : Preston display of Aircraft Situational Display to Industry information
- FlightViz workstation : Jeppesen positional map display
- VSOC workstation : Autometric Visual Security Operations Console to monitor & control security cameras

# Factoria lab

- AADS –Radar weather display (FLT 6); Flight surveillance & track deviation (FLT 7); alert generation (FLT 9); Aircraft surveillance loss alert (FLT 10)

- Track II – Flight surveillance & traffic (FLT 7)

- Cockpit Audio (FLT 3)

AADS

Lab-Lab  
VTC

Track  
II

Cockpit  
Audio

ARINC 429  
FLTVIZ

VSOC

Video

- ARINC 429 - Aircraft Data parameters (Weather data) (FLT 6)

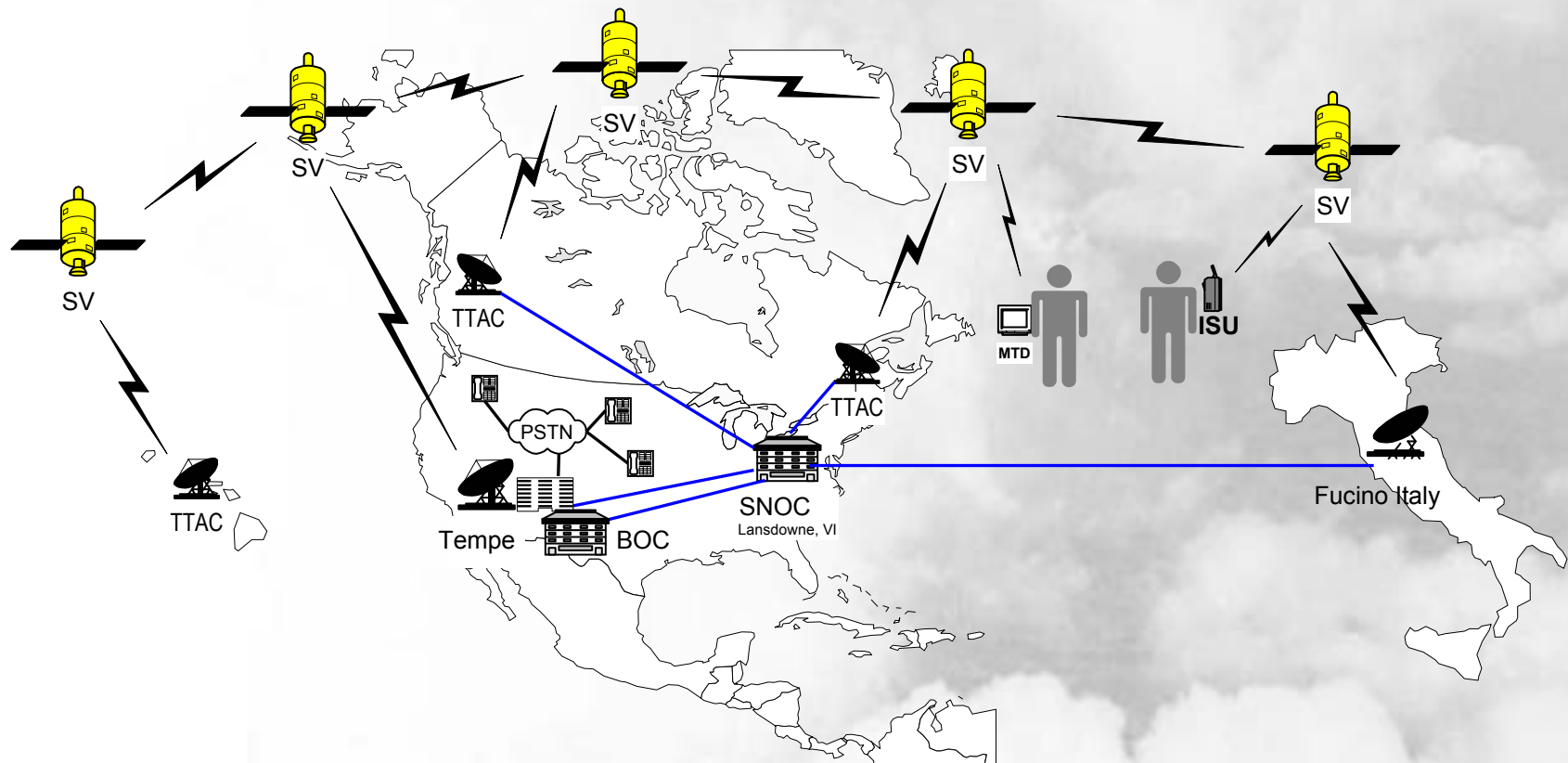
- FLTVIZ (FlightViz), ARINC 429 – Aircraft surveillance & track deviation alerts & alarms (FLT 7,8)

- VSOC (Visual Security Operations Console, VSOC) - 3D high-resolution graphical interface to an on-board Video Surveillance & Recording system (FLT 5)

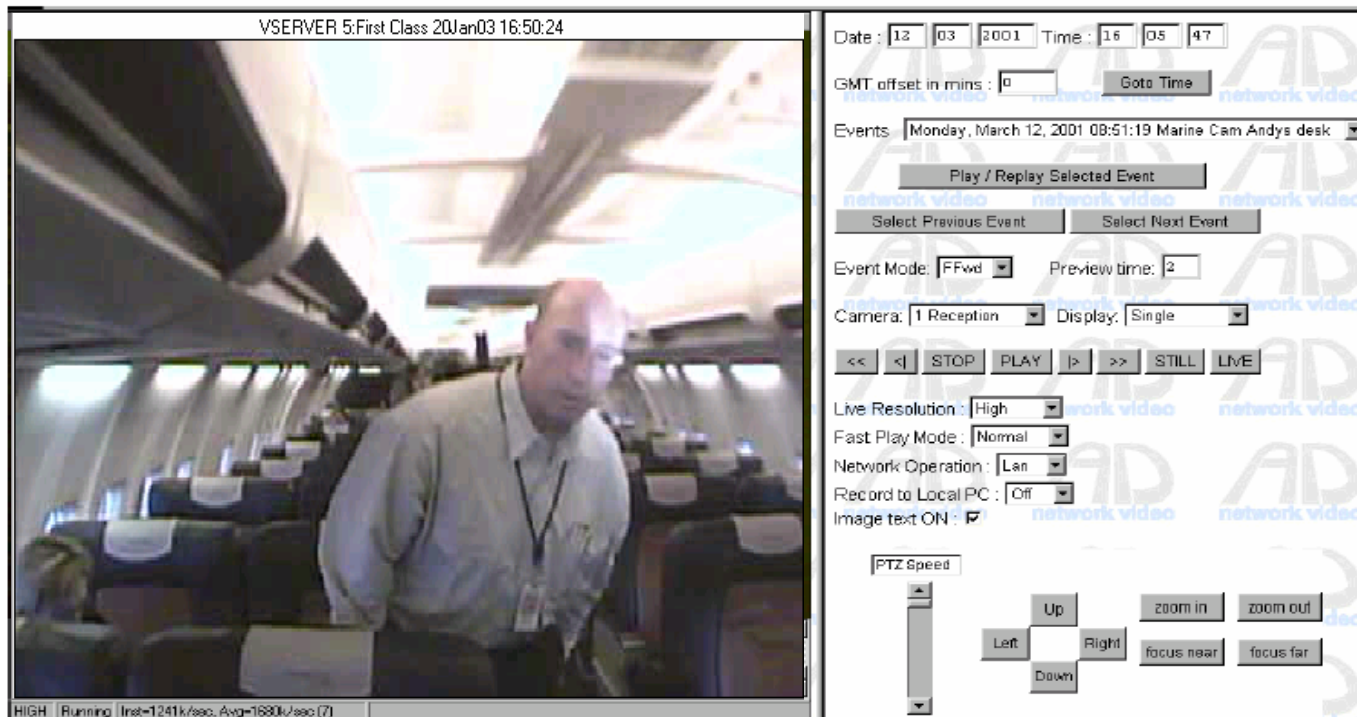
- Video – Onboard cabin & hold video; record & playback (FLT 3)

- Network satellite connectivity & Broadband & Narrowband satellite-based communications are demonstrated across lab applications & displays (FLT 1,2)

# Narrowband satellite link (Iridium L-Band System)

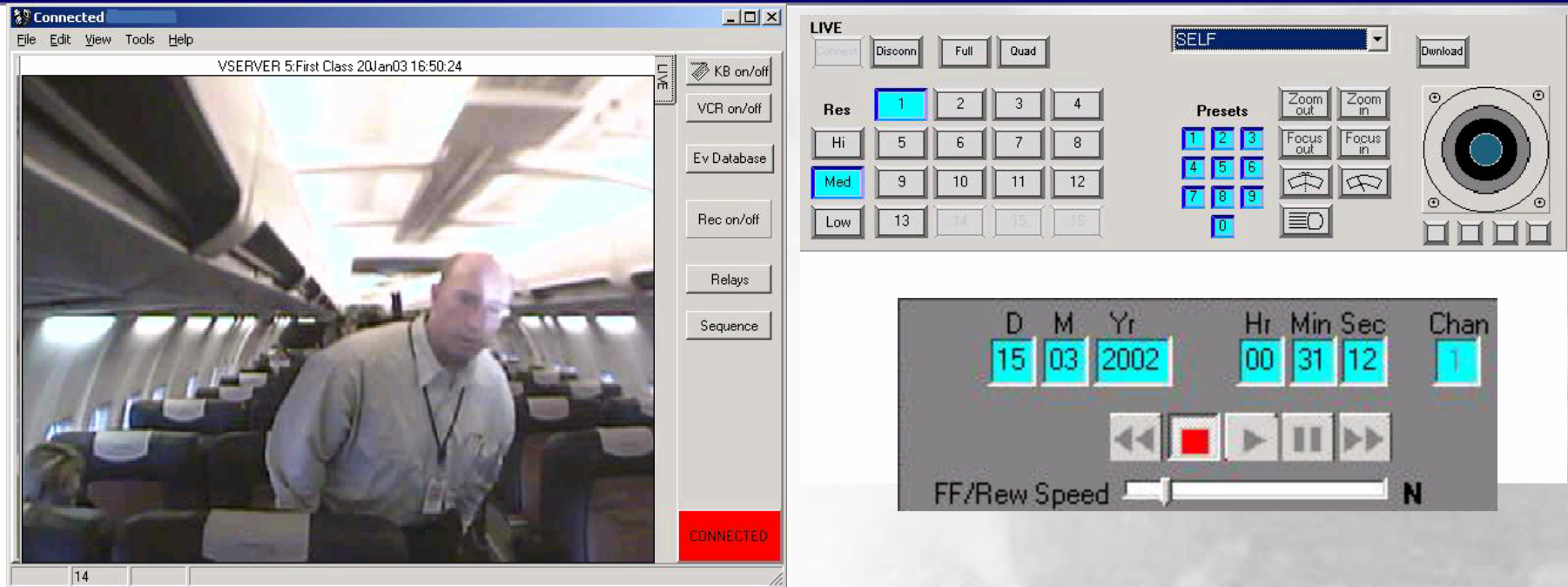


# Video surveillance system



- Provide on demand real time and recorded video
- Multiple and simultaneous video feeds to remote clients
- Independent control of camera views by remote clients
- Provide video feed to PC workstations and portable devices (laptops and PDAs)

# Client video display and control panel



- Simple, intuitive controls similar to a VCR
- Choice of full or multiple camera views
- Provide access to live and recorded video feeds

# VSOC: Scanning Mode

